

# Emily Goldberg, Ph.D

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## EDUCATION

- 2014 - 2020      Postdoctoral Fellow, Department of Comparative Medicine and Department of Immunobiology. Yale University.  
                         Advisor: Vishwa Deep Dixit, PhD
- 2008 - 2014      Doctorate of Philosophy in Nutritional Sciences with a minor in Immunobiology. The University of Arizona.  
                         Advisor: Janko Nikolich-Zugich, MD, PhD  
                         Dissertation Title: Lifespan Extension and Immune Competence
- 2004 - 2008      Bachelors of Science in Biochemistry and Molecular Biophysics  
                         Bachelors of Science in Molecular and Cellular Biology.  
                         Minor in mathematics. The University of Arizona.

## EMPLOYMENT

- 2020 - present      Assistant Professor, Department of Physiology, UCSF

## PUBLICATIONS

### Scientific Articles

1. Non-specific recognition of histone modifications by H3K9rbhb antibody. Tsusaka T, Oses-Prieto JA, Lee C, DeFelice BC, Burlingame AL, **Goldberg EL**. iScience. 2023 Jun 29;26(7):107235. doi: 10.1016/j.isci.2023.107235. eCollection 2023 Jul 21. PMID: 37485368
2. Innate immune cell-intrinsic ketogenesis is dispensable for organismal metabolism and age-related inflammation. **Goldberg EL\***, Letian A, Dlugos T, Leveau C, Dixit VD\*. J Biol Chem. 2023 Mar;299(3):103005. doi: 10.1016/j.jbc.2023.103005. Epub 2023 Feb 10. PMID: 36775129  
\*co-corresponding authors  
- Featured in ASBMB Today
3. Zhang X, McDonald JG, Aryal B, Canfrán-Duque A, **Goldberg EL**, Araldi E, Ding W, Fan Y, Thompson BM, Singh AK, Li Q, Tellides G, Ordovás-Montañes J, García

- Milian R, Dixit VD, Ikonen E, Suárez Y, Fernández-Hernando C. Desmosterol suppresses macrophage inflammasome activation and protects against vascular inflammation and atherosclerosis. *Proc Natl Acad Sci U S A*. 2021 Nov 23;118(47):e2107682118. doi: 10.1073/pnas.2107682118. PMID: 34782454
4. **Goldberg EL\***, Shchukina I, Youm YH, Ryu S, Tsusaka T, Young KC, Camell CD, Dlugos T, Artyomov MN, Dixit VD\*. IL-33 causes thermogenic failure in aging by expanding dysfunctional adipose ILC2. *Cell Metab*. 2021 Aug 26:S1550-4131(21)00367-3. doi: 10.1016/j.cmet.2021.08.004. PMID: 34473956  
\*co-corresponding authors  
- Research Highlight: Nature Reviews Endocrinology
5. **Goldberg, E.L.**, Shchukina, I., Asher, J.L., Sidorov, S., Artyomov, M.N., Dixit, V.D. (2020) Ketogenesis activates metabolically protective  $\gamma\delta$  T cells in visceral adipose tissue. *Nature Metabolism* Published online January 20, 2020.  
- Article selected for Nature Metabolism News & Views  
- Research Highlight: Nature Immunology
6. **Goldberg, E.L.**, Molony, R.D., Kudo, E., Sviatoslav, S., Kong, Y., Dixit, V.D., Iwasaki, A. (2019) Ketogenic diet activates protective  $\gamma\delta$  T cell responses against influenza virus infection. *Science Immunology* 2019 Nov 15;4(41). doi: 10.1126/sciimmunol.aav2026. PMID: 31732517
7. Camell C.D., Günther P., Lee A., **Goldberg E.L.**, Spadaro O., Youm Y.H., Bartke A., Hubbard G.B., Ikeno Y., Ruddle N.H., Schultze J., Dixit V.D. Aging Induces an Nlrp3 Inflammasome-Dependent Expansion of Adipose B Cells That Impairs Metabolic Homeostasis. *Cell Metab* 2019 Dec 3;30(6):1024-1039.e6. doi: 10.1016/j.cmet.2019.10.006. PMID: 31735593
8. Camporez J.P., Lyu K., **Goldberg E.L.**, Zhang D., Cline G.W., Jurczak M.J., Dixit V.D., Petersen K.F., Shulman G.I. Anti-inflammatory effects of estrogen mediate the sexual dimorphic response to lipid-induced insulin resistance. *J Physiol*. 2019 June 17. PMID: 31206703
9. Camell CD, Sander J, Spadaro O, Lee A, Nguyen KY, Wing A, **Goldberg EL**, Youm YH, Brown CW, Elsworth J, Rodeheffer MS, Schultze JL, Dixit VD. Inflammasome-driven catecholamine catabolism in macrophages blunts lipolysis during ageing. *Nature*. 2017 Oct 5;550(7674):119-123. PMID: 28953873
10. **Goldberg, E.L.**, Asher, J.L., Molony, R.D., Shaw, A.C., Zeiss, C.J., Wang, C., Morozova-Roche, L.A., Herzog, R.I., Iwasaki, A., Dixit, V.D. (2017)  $\beta$ -hydroxybutyrate deactivates neutrophil NLRP3 inflammasome to relieve gout flares. *Cell Reports* Feb 28;18(9):2077-2087. PMID 28249154

11. **Goldberg, E.L.** and Dixit, V.D. (2017) Carnitine acetyltransferase (CRAT) expression in macrophages is dispensable for nutrient stress sensing and inflammation. *Molecular Metabolism* Jan 3;6(2):219-225. PMID 28180063
12. Spadaro O., **Goldberg, E.L.**, Camell, C.D., Youm, Y., Kopchick, J.J., Nguyen, K.Y., Bartke, A., Sun, L.Y., Dixit, V.D. (2016) Growth hormone receptor deficiency protects against age-related NLRP3 inflammasome activation and immune-senescence. *Cell Reports* Feb 23;14(7):1571-80. PMID 26876170
13. Youm, Y.H., Nguyen, K.Y., Grant, R.W., **Goldberg, E.L.**, Bodogai, M., Kim, D., D'Agostine, D., Planavsky, N., Lupfer, C., Kanneganti, T.D., Kang, S., Horvath, T.L., Fahmy, T.M., Crawford, P.A., Biragyn, A., Alnemri, E., Dixit, V.D. (2015) The ketone metabolite  $\beta$ -hydroxybutyrate blocks NLRP3 inflammasome-mediated inflammatory disease. *Nat. Med.* 21(3):263-9. PMID: 25686106.
  - Editor's Highlight: Nature Reviews Immunology, Neurology
  - Spotlight: Trends in Immunology
  - Commentaries: Nature Medicine, Cell Metabolism
14. **Goldberg, E.L.**, Romero-Aleshire, M.J., Renkema, K.R., Ventevogel, M.S., Chew, W.M., Uhrlaub, J.L., Smithey, M.J., Limesand, K.H., Sempowski, G.D., Brooks, H.L., Nikolich-Zugich, J. (2015) Lifespan-extending calorie restriction or mTOR inhibition impair adaptive immunity of old mice by distinct mechanisms. *Aging Cell*. 14(1): 130-8. PMID: 25424641.
  - Article selected for Faculty of 1000 by Lucio Comai
15. **Goldberg, E.L.**, Smithey, M.J., Lutes, L.K., Uhrlaub, J.L., Nikolich-Zugich, J. (2014) Immune memory-boosting dose of rapamycin impairs macrophage vesicle acidification and curtails glycolysis in effector CD8 cells, impairing defense against acute infections. *J Immunol.* 193(2): 757-63. PMID: 24913978.
16. Kusne, Y.\*, **Goldberg, E.L.**\*, Parker, S.S., Hapak, S.M., Maskaykina, I.Y., Chew, W.M., Limesand, K.H., Brooks, H.L., Price, T.J., Sanai, N., Nikolich-Zugich, J., Ghosh, S. (2014) Contrasting effects of chronic, systemic treatment with mTOR inhibitors rapamycin and metformin on adult neural progenitors in mice. *Age* (Dordr). 36(1): 199-212. PMID: 23949159. \*Authors contributed equally
17. 13. Rudd, B.D., Venturi, V., Smith, N.L., Nzingha, K., **Goldberg, E.L.**, Li, G., Nikolich-Zugich, J., Davenport, M.P. (2013) Acute neonatal infections 'lock-in' a suboptimal CD8+ T cell repertoire with impaired recall responses. *PLoS Pathog.* 9(9):e1003572. PMID: 24068921.

## Reviews and Editorials

1. **Goldberg EL.** Glucose restriction in antiviral defence. *Nat Immunol.* 2024 Jun;25(6):941-943. PMID: 38811817
2. Gonzatti, M.B. and **Goldberg, E.L.** Ketone bodies as chemical signals for the immune system. *Am J Physiol Cell Physiol.* 2024 Mar 1;326(3):C707-C711 PMID: 38189135
3. **Goldberg, E.L.** Integration of immune-metabolic signals to preserve healthy aging. *Translational Medicine of Aging* published online July 24, 2020 <https://doi.org/10.1016/j.tma.2020.07.005>
4. Stubbs, B.J., Koutnik, A.P., **Goldberg, E.L.**, Upadhyay, V., Turnbaugh, P.J., Verdin, E., Newman, J.C. Investigating ketone bodies as immunometabolic countermeasures against respiratory viral infections. *Cell Med.* Published online July 15, 2020
5. **Goldberg, E.L.**, Dixit, V.D. Bone Marrow: An Immunometabolic Refuge during Energy Depletion. *Cell Metab.* 2019 Oct 1;30(4):621-623. PMID: 31577929
6. **Goldberg, E.L.** and Dixit, V.D. (2015) Drivers of age-related inflammation and strategies for healthspan extension. *Immunol Rev.* 265(1):63-74. PMID 25879284
7. **Goldberg, E.L.** and Dixit, V.D. (2015) "Crowning" eosinophils in adipose tissue: does location matter? *J Leukoc Biol.* Oct;98(4):451-2. PMID 26429777
8. Camell, C., **Goldberg, E.**, Dixit, V.D. (2015) Regulation of Nlrp3 inflammasome by dietary metabolites. *Seminars in Immunology* 27:334-342. PMID 26776831

## Book Chapters

1. **Goldberg, E.L.**, Shaw, A.C., Montgomery, R.R. How Inflammation Blunts Innate Immunity in Aging. Weinberger B (ed): Vaccines for Older Adults: Current Practices and Future Opportunities. *Interdiscip Top Gerontol Geriatr.* 2020, vol 43, pp 1–17 PMID: 32294641

## Pre-prints

1. Tsusaka T, Najar MA, Schwarz B, Bohrnsen E, Oses-Prieto JA, Lee C, Burlingame AL, Bosio CM, Burslem GM, **Goldberg EL.** Reversible histone deacetylase activity catalyzes lysine acylation. *bioRxiv.* 2023 Nov 17:2023.11.17.567549. doi: 10.1101/2023.11.17.567549. Preprint. PMID: 38014285

## FUNDING

### Current

- 2022 - 2027 NIH DP2AI175641 NIH Common Fund  
"Discovering mechanisms of tissue-resident immune aging"
- 2021 - 2024 Norn Group, Aging Impetus Grants  
"Identifying sources of circulating factors during aging"
- 2020 - 2024 Chan Zuckerberg Biohub Investigator Award
- 2024 - 2025 Bakar Aging Research Institute Collaborative Project Award  
"Using Osteoarthritis as a Model to Dissect the Role of Adipose Tissue in Multi-Organ Aging"

## Completed

- 2023 - 2024 PBBR New Frontiers Research Award
- 2023 - 2024 PBBR Technologies, Methodologies, and Cores Award
- 2021 - 2022 BAKAR Aging Research Institute Investigator Award  
"Aging of adipose-resident immune cells"
- 2020 - 2023 R00 AG058801 National Institute on Aging  
"Impact of ketone bodies on age-related inflammation and healthspan extension"
- 2020 - 2020 UCSF NORC Pilot & Feasibility Award
- 2020 - 2021 UCSF Liver Center Pilot & Feasibility Award
- 2019 - 2020 K99 AG058801 National Institute on Aging  
"Impact of ketone bodies on age-related inflammation and healthspan extension"
- 2016 - 2018 American Heart Association Postdoctoral Fellowship  
"Impact of ketone metabolites on obesity-related inflammation"
- 2016 - 2018 American Federation for Aging Research Postdoctoral Fellowship  
"Impact of ketone metabolites on age-related inflammation"

## INVITED SPEAKER

- 2025 Diet and Optimum Health Conference 2025, Linus Pauling Institute, Oregon State University, Corvallis, OR
- 2025 Gerontological Society of America, session on Immunological Aspects of Aging
- 2025 Baylor College of Medicine, Department of Molecular and Cellular Biology, Houston, TX
- 2024 San Jose State University, Systems Physiology Laboratory, Student-invited speaker, San Jose, CA
- 2024 ISIN XIII Conference on Immunonutrition, session on Immunonutrition and Disease

- 2024 University of Utah Department of Nutrition and Integrative Physiology, Salt Lake City, UT
- 2024 University of Pittsburgh Vascular Medicine Institute Center for Immunometabolism, Pittsburgh, PA
- 2024 University of Washington at St. Louis Department of Cell Biology and Physiology, St. Louis, MO
- 2024 American Physiology Society Summit 2024, Long Beach, California
- 2024 Marabou Symposium "Nutrition and Immunity: Individual Variation in Response" Stockholm, Sweden
- 2024 University of Michigan, Department of Immunology and Microbiology, Ann Arbor, MI
- 2024 American Aging Association 52nd Annual Meeting
- 2023 13th Annual Fox Chase Cancer Center Scientific Symposium: Aging & Cancer, Philadelphia, PA
- 2023 University of Texas at Austin, Department of Nutritional Sciences, Austin, TX
- 2023 NIAID/NIA/NIDCR "Advances in Aging, Immunity, and Chronic Inflammatory Disease" Workshop
- 2023 Chan Zuckerberg Initiative "Metabolism Across Scales" Workshop
- 2023 University of Minnesota Department of Pharmacology
- 2023 University of Missouri, Department of Biochemistry, Colombia, MO
- 2023 Ragon Institute of MGH, MIT, and Harvard seminar series. Boston, MA
- 2023 UCSF Department of Cellular and Molecular Pharmacology faculty lunch seminar series
- 2023 UCSF Diabetes Research Center
- 2022 XLVI Congress of the Brazilian Society of Immunology - IMMUNO 2022 Annual Meeting. Sao Paulo, Brazil
- 2022 UC Berkeley Department of Nutritional Sciences and Toxicology seminar series
- 2022 UC Davis Innovation Institute for Food and Health
- 2022 ICSF IgEquity Women in Immunology Symposium
- 2021 IL-33 causes thermogenic failure in aging by expanding dysfunctional adipose ILC2. Systems Immunology in Aging and Complex Disease. Jackson Labs, virtual symposium.
- 2021 IL-33 causes thermogenic failure in aging by expanding dysfunctional adipose ILC2. Society for Leukocyte Biology annual meeting, virtual symposium
- 2020 UCSF Parnassus Faculty Lunch seminar series
- 2020 Dysregulation of adipose ILC2 underlies thermogenic failure in aging. Bay Area Metabolism Meeting 2020.
- 2020 Dysregulation of the adipose-resident immune compartment during aging. Society for Leukocyte Biology online webinar during COVID-19

- 2020 Defects in adipose-resident immune cells underlie age-related metabolic defects. Aging Science Talks, online series during COVID-19
- 2019 Dysregulation of the adipose-resident immune compartment during aging. UCSF Diabetes Research Center Retreat
- 2019 Metabolic Regulation of Inflammation and Protective Immunity. UT Southwestern Touchstone Diabetes Center, Dallas, TX.
- 2019 Metabolic regulation of tissue-protective immunity. NIH Geroscience Interest Group Symposium: Tissue-Resident Immune Cells. Bethesda, MD
- 2019 Metabolic adaptation triggers protective immune activation. Department of Nutritional Sciences, University of Arizona.
- 2018 Regulation of Systemic inflammation by metabolic substrates. 6<sup>th</sup> Global Symposium on Ketogenic Therapies for Neurological Disorders (KETO 2018), Jeju, South Korea.

## HONORS AND AWARDS

- 2024 – 2027 Jack D. and DeLoris Lange Endowed Chair in Systems Physiology I (3-year titleship)
- 2023 Distinguished Lecturer Award, University of Texas at Austin
- 2023 Shideman-Sterline Lectureship Award, University of Minnesota
- 2022 National Institutes of Health New Innovator Award
- 2021 BAKAR Aging Research Institute Investigator
- 2020 Chan Zuckerberg Biohub Investigator
- 2019 The AAI Young Investigator Award. La Jolla Immunology Conference
- 2019 The Ray Owen Young Investigator Award. Outstanding oral presentation, Midwinter Conference of Immunologists.
- 2018 Society of Leukocyte Biology Trainee Award
- 2016 American Heart Association Postdoctoral Fellowship
- 2015 American Federation for Aging Research Postdoctoral Fellowship

## TEACHING EXPERIENCE

### Training

- 2024 UCSF-CCSF Inclusive Research Mentor/Manager Series
- Effectively supervising people who aren't you: Managing different workstyles?
  - Teach/train and delegate: Using best practices to train your diverse team
- 2020 Diversity, Equity, and Inclusion Champion Training

2019	Cold Spring Harbor Laboratory: Workshop on Leadership in Bioscience.
2018	“Mentoring in the Sciences” workshop offered by Yale Postdoctoral Association
2018	Fundamentals of Teaching in the Sciences. Two-week workshop offered by the Yale Center for Teaching and Learning.

## Courses

Fall 2024	Tetrad Graduate Program “Cell Biology” Discussion
2011-2014	Teaching Assistant for online Nutritional Science General Education course during winter and summer sessions. Responsibilities include grading assignments and frequent email correspondence with students and instructor.
2008-2010	Teaching Assistant for undergraduate Nutritional Science General Education course. I was responsible for leading discussion sections of 50 students every week and grading assignments.
2008-2010	Teaching Assistant for advanced Nutritional Metabolism Course. I was responsible for leading weekly review sessions and grading assignments. I also gave several lectures each semester.

## Mentoring

2023 - present	Anna Pi, UC Berkeley Metabolic Biology graduate student
2022 - present	Anudari Letian, Postdoc (BAKAR Aging Research Institute Fellow 2023-2024)
2021 - present	Takeshi Tsusaka, Postdoc (JSPS Fellow 2021-2023)
2020 - 2022	Christina Lee, UC Berkeley MCB undergraduate
2020 - 2021	Kyrlia Young, Junior Specialist
2018 - 2020	Andrew Takeda, Yale Immunobiology PhD student
2018 - 2020	Elsie Gonzalez-Hurtado, Yale MD/PhD student
2017	Agrani Dixit, high school student, currently undergrad at Bryn Mawr
2013 - 2015	Lydia Lutes MCB Undergraduate, currently a postdoc with Dr. Christoph Scheiermann, Université de Genève

## Student Committees

2024	Alexander Vu, Qualifying exam committee, Tetrad
2022 - present	Owen Jiang, Thesis committee, Biomedical Sciences
2022	Owen Jiang, Qualifying exam committee chair, Biomedical Sciences
2022	Rachel Rock, Qualifying exam committee, Biomedical Sciences
2022	Arka Rao, Qualifying exam committee, Chemistry and Chemical Biology

- 2022 - present Joyce Yang, Thesis committee, Neuroscience  
2021 - present Regan Volk, Thesis committee, Chemistry and Chemical Biology  
2021           Regan Volk, Qualifying exam committee, Chemistry and Chemical  
2021 - 2023   Brenda Eap, Thesis committee, Biology of Aging USC/Buck  
                 Institute  
2021           Brenda Eap, Qualifying exam committee, Biology of Aging USC/Buck  
                 Institute

## PROFESSIONAL SERVICE/OUTREACH

### **Scientific Societies**

- 2013-present American Association of Immunologists  
2015-present American Aging Association  
2016-present Society for Leukocyte Biology  
2016-2018   American Heart Association

### **Service/Outreach**

- 2024           Stanford NORC Pilot & Feasibility Grant reviewer  
2024           American Diabetes Association 85th Scientific Sessions Insulin  
                 Action/Molecular Metabolism Subcommittee  
2023 - 2024   UCSF BMS graduate program retreat co-organizer  
2023           CZI "Metabolism Across Scales" Grant Reviewer  
2023           UCSF Department of Biochemistry Faculty Search committee  
                 member  
2023           Reviewer NIH/NIA SEP "Immunity in Older Adults"  
2022           UCSF Department of Physiology faculty search committee member  
2021 - present   American Federation for Aging Research National Scientific  
                 Advisory Council  
2021 - 2023   Ad hoc reviewer for NIH "Inflammation and Innate Immunity" Study  
                 Section  
2021 - present   Department Diversity Leaders  
2021           Nathan Shock Center - San Antonio Barshop Institute external  
                 grant reviewer  
2019           Connecticut STEM Foundation Science Fair, Judge  
2018           Women in Science at Yale mentoring program  
2017           AAI Capitol Hill Day lobbying congress to support NIH funding  
2016           Meeting with Arizona graduate students to discuss transitioning to  
                 postdoc

**Journal Reviewer**

Nature, Nature Immunology, Science Translational Medicine, Cell Metabolism, Nature Metabolism, Science Advances, Journal of Leukocyte Biology, American Journal of Physiology, Obesity, Arthritis & Rheumatology, Nature Communications, Aging Cell, Journal of Immunology, Geroscience, Cellular Immunology, Cell Reports